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CORN, MILO, AND KAFIR IN THE SOUTHERN GREAT PLAINS AREA: RELATION OF CULTURAL METHODS TO PRODUCTION.

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INTRODUCTION.

This bulletin embodies the results of a study of methods of production of three important feed crops—corn, milo, and kafir—at three field stations on the southern Great Plains. The data presented have been obtained at Garden City, Kans., and at Dalhart and Amarillo, Tex. Experimental work with these crops has been conducted at Akron, Colo.; Hays, Kans.; and Tucumcari, N. Mex.; but the results obtained at these stations are not included in this study. At Akron very little grain has been produced by either milo or kafir, and it is generally conceded that this station is beyond the northern limit at which these crops can be profitably grown at this altitude. At Hays the small size of the plats used in the experimental work has subjected milo and kafir to influences, such as ravages by insects, that are not ordinarily experienced under field conditions. The data are therefore not sufficient to permit adequate comparison either of the crops grown here and at other stations or of different methods of producing them at this station. Better yields have been obtained with corn at both of these stations, but as there are no results from other crops with which to compare them they are not given in this publication. At Tucumcari the work has not been carried on for a sufficient length of time to obtain averages or to warrant the drawing of definite conclusions. It is probable, however, that what may be said of crops at the other three stations under consideration will, in a general way, also apply to the Tucumcari district.

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[1] During the progress of this work, the following assistants in the Office of Dry-Land Agriculture have had charge of the details of the investigations: R. W. Edwards, 1911 and 1912, and J. G. Lill, 1913 and 1914, at Garden City, Kans.; F. L. Kennard, 1908 to 1910, and C. B. Brown, 1913 and 1914, at Dalhart, Tex.; and L. E. Hazen, 1911 and 1912, at Amarillo, Tex. The work at Amarillo, Tex., is in cooperation with the Office of Cereal Investigations of the United States Department of Agriculture, while at Garden City, Kans., it is in cooperation with the Kansas Agricultural Experiment Station. The Biophysical Laboratory has cooperated in obtaining the meteorological data reported.

Note.—This bulletin is intended for all who are interested in the agricultural possibilities of the southern Great Plains area.

With this brief statement the work at these three stations will not be further considered, and the study will be confined to the results obtained at Garden City, Dalhart, and Amarillo. Although these stations are located some distance apart, they are confronted by general problems that are much the same, the local differences being in their intensity rather than in their nature. In order that the characteristics of this section may be more clearly understood, a brief account of the climatic and soil conditions is given here.

CLIMATIC CONDITIONS.

In a general way the climatic conditions at each of these three stations, in so far as they materially influence crop results, may be briefly described as follows: A limited annual rainfall of irregular distribution, a high wind velocity, a very high rate of evaporation, possible hail, and in the higher altitudes violent fluctuations in temperature. All of these factors will be discussed separately and for each station under consideration.

PRECIPITATION.

Rainfall is the most important factor influencing crop production in this section. In determining its influence, it is important that the distribution be considered as well as the total quantity. In a great many instances the distribution may have even greater influence than the total annual precipitation in determining crop production. It frequently happens in the case of torrential rainfall that a large percentage of the water will be lost by run-off. On the other hand, frequent light showers may at the end of the year give a large aggregate rainfall. These light showers wet only the surface soil, and the moisture may be lost by evaporation before another shower falls. Consequently, light showers may be of little value to growing crops. In any study of annual precipitation records of the distribution must be considered before its effects can be completely understood. To afford some means of general comparisons, the annual rainfall record for each of these three stations is given in Table I.

At Garden City the average annual precipitation for the years 1897 to 1914, inclusive, was 19.64 inches. At Dalhart, for the years 1908 to 1914, inclusive, the average annual precipitation was 15.92 inches. At Amarillo precipitation records are available for the 23 years from 1892 to 1914, inclusive. These records show that the average annual precipitation was 20.95 inches.

TABLE I.—*Monthly, annual, and average precipitation at Garden City, Kans., and at Dalhart and Amarillo, Tex., for the years stated.*

[Data in inches. Records for 1897 to 1907, inclusive, at Garden City, and for 1892 to 1906, inclusive, at Amarillo, were furnished by the United States Weather Bureau.]

Station and year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Garden City, Kans.:													
1897	0.01	2.33	0.19	2.09	0.61	3.19	3.49	5.80	0.33	1.78	[1] T.	0.50	20.32
1898	1.55	0	.50	.97	6.49	6.39	2.59	2.04	4.24	.43	1.55	2	28.75
1899	.35	1.18	1.30	1	.42	4.40	6.21	1	1.93	.75	1.26	.78	20.58
1900	.15	.88	1.22	5.20	2.05	2.79	2.18	.80	3.10	.52	T.	.40	19.29
1901	.20	.55	2.20	3.90	1.20	1.30	1.48	2.03	4.57	.60	0	.31	18.34
1902	.25	.87	2.46	.70	6.26	2.43	.98	.88	1	2.62	.20	1	19.65
1903	.25	4.45	.70	5.10	1.49	2.83	.77	3.65	.35	.40	.40	.25	20.64
1904	.10	T.	.11	.95	4.30	2.64	5.65	1.32	3.39	1.20	.09	1.30	21.05
1905	1.10	.71	1.30	5.70	1.47	4.57	.86	.57	1.05	.55	3.10	.05	21.03
1906	.30	.43	1.60	3.24	1.92	4.47	5.82	1.50	3.05	3.46	1.32	T.	27.11
1907	.15	.25	.48	.91	2.44	2.55	6.35	1.62	2.59	1.45	.16	2	20.95
1908	.08	.67	.18	.50	.78	3.45	1.52	1.61	.61	.99	2.72	.23	13.34
1909	.30	.35	2.15	.07	2.50	3.44	5.10	1.31	1.43	.68	3.77	.70	21.80
1910	.50	.25	T.	1.04	1.52	3.23	2	2.99	.14	T.	.15	T.	11.82
1911	T.	3.53	.89	.32	3.19	.61	1.84	1.68	.23	1.85	.95	1.66	16.75
1912	.28	3.04	.98	2.55	.56	4.07	1.76	3.49	1.34	.33	.29	.05	18.74
1913	.15	1.15	.50	1.21	2.30	3.12	4.97	.87	5.47	.23	1.19	2.42	23.58
1914	0	T.	T.	1.74	3.63	1.44	.56	.64	.15	1.48	T.	.06	9.70
Mean	.32	1.15	.93	2.07	2.40	3.16	3.01	1.88	1.94	1.07	.95	.76	19.64
Dalhart, Tex.:													
1908	T.	.85	.04	2.28	.53	2.83	4.11	1.08	.39	.29	.99	0	13.39
1909	T.	.28	.71	.18	1.70	5.10	1.27	.65	2.12	2.60	1.21	.15	15.97
1910	.20	.03	.12	1.51	2.96	4.04	2.48	3.28	.05	0	.07	.02	14.76
1911	0	.54	.43	.59	3.37	.28	3.65	1.87	.58	1.72	.25	1.28	14.56
1912	0	1.30	.38	2.56	2.37	3.36	1.68	2.64	1.98	.05	0	.03	16.35
1913	.06	.14	.02	.88	2.35	1.29	.85	1.50	1.45	.09	1.78	3.18	13.59
1914	.05	T.	T.	3.98	7.29	3.65	2.58	1.38	.32	3	0	.56	22.81
Mean	.04	.45	.24	1.71	2.94	2.94	2.37	1.77	.98	1.11	.61	.75	15.92
Amarillo, Tex.:													
1892	.42	.57	2.10	.21	2.70	1.49	1.85	1.93	.24	2.85	.16	1.08	15.60
1893	.09	2.03	T.	.16	2.19	2.03	2.05	2.67	5.27	.03	.28	.43	17.23
1894	.02	1.15	.05	.85	1.30	3.59	1.82	3.41	2.41	.39	0	.82	15.81
1895	1.60	1.92	.16	1.31	1.78	6.84	2.83	3.87	.57	2.26	.81	.79	24.79
1896	.76	.41	.21	1.95	2.20	2.31	7.04	.63	2.45	3.09	.35	2.88	24.28
1897	2.26	.65	.47	1.08	4.44	2.32	2.16	2.71	.73	1.63	.08	.63	19.16
1898	.86	.82	.35	.98	3.52	4.81	3.88	4.03	.48	.41	.34	2.06	22.54
1899	.29	.07	.17	.23	3.12	4.45	6.96	.51	6.09	1.15	3.24	1.11	27.39
1900	.59	.47	.48	5.47	4.53	1.84	3.21	.83	5.25	1.58	.08	.07	24.40
1901	.03	.48	.02	4.90	5.99	.92	1.56	3.03	2.19	3.26	2	.04	24.42
1902	.04	T.	.74	1.83	9.14	2.01	1.45	2.42	.95	1.74	2.24	.55	23.11
1903	.12	2.93	.26	.90	1.79	2.83	3.38	4.67	.82	2.58	0	T.	20.28
1904	.16	.08	T.	.63	2.88	5.53	2.48	4.69	3.55	.44	.20	.69	21.33
1905	1	1.52	2.62	4.52	6.16	2.19	3.76	.63	3.08	.30	5.09	1.45	32.32
1906	.41	.51	.64	3.23	1.18	2.07	2.90	6.76	1.96	2.49	2.58	.19	24.92
1907	1.11	.24	.02	1.30	1.13	2.23	1.47	6.15	.97	1.64	.69	1.46	18.41
1908	.26	.72	T.	1.86	3.44	1.73	4.64	3.39	1.50	.37	.51	0	18.42
1909	.07	.28	1.08	.27	1.13	5.90	2.19	1.39	1.90	1.18	3.25	.54	19.18
1910	.05	.17	.41	.53	2.61	1.48	2.61	2.46	.05	.13	.19	T.	10.69
1911	.07	3.26	.50	3.90	6.74	.35	5.92	2.54	1.30	1.53	.55	1.14	27.80
1912	T.	1.85	.78	.82	1.62	2.31	2.50	1.51	2.28	.33	T.	.33	14.33
1913	.01	.41	.44	1.69	1.71	2.29	1.40	.47	5.60	.83	2.26	2.17	19.28
1914	T.	.01	.02	1.27	3.83	.65	1.90	2.52	1.10	3.98	0	.87	16.15
Mean	.44	.89	.50	1.73	3.27	2.70	3.04	2.75	2.21	1.49	1.08	.84	20.95

[1] T=Trace.

It will be noted that at each of the stations, from 40 to 45 per cent of the total precipitation falls during the growing season of the crops studied; that is, in the months of June, July, and August.

WIND VELOCITY.

Considered as a whole, the southern portion of the Great Plains has a high wind velocity. It is not, however, the high average velocity as much as the occasional high winds, which usually last only a short time, that must be considered as the injurious factor in crop production. The damage to crops in this region by wind may be accomplished either by soil blowing, by excessive transpiration from the leaf surface, or by direct loss of soil moisture by drying. Transpiration from the leaf surface is an uncontrollable factor in crop production and will not be further discussed. The wind reaches its maximum velocity during the months of March, April, and May, although there are occasional days throughout the entire year when the velocity is high. Wind velocity, in so far as its soil-blowing effect is concerned, does not readily lend itself to any form of scientific measurement, and data other than those gathered by general observations can not be given. The extent to which wind velocity may affect soil movement also depends largely upon the condition of the surface soil.

EVAPORATION.

The amount of evaporation from a free water surface during the growing season is very high in the southern portion of the Great Plains. This is due to a combination of high altitude, dry air, excessive wind, high temperatures, and long periods of drought. The seasonal evaporation for this area is about 55 inches, as compared with about 30 inches for the northern portion of the Great Plains. This relatively high evaporation doubtless accounts for some of the differences in crop yields. It is also one of the determining factors in the crop variety which can be successfully produced in this region.

The amount of evaporation from a free water surface should not be confused with the evaporation from the soil except that it may offer rather a close relation to the water lost from the first few inches of soil when the soil is thoroughly saturated. Considerable work is now being done at all of these stations to determine the rate and amount of water lost from the soil by evaporation, but this subject will not be considered here.

Table II gives the monthly and seasonal evaporation in inches from a free water surface at the level of the ground at the Garden City, Dalhart, and Amarillo stations for the years during which the experiments here reported have been conducted.

TABLE IV.—*Monthly and seasonal evaporation at Garden City, Kans., and at Dalhart and Amarillo, Tex., for the years stated.*

[Data in inches.]

Station and year.	Apr.	May.	June.	July.	Aug.	Sept.	Total.
Garden City, Kans.:							
1908	9.02	9.86	10.56	9.46	9.69	7.61	56.13
1909	6.57	9.10	8.76	9.80	9.88	7.46	51.56
1910	7.76	6.33	9.43	10.47	7.63	6.81	48.41
1911	7.10	9.72	11.85	10.25	10.24	8.86	58.02
1912	6.80	10.82	8.58	10.64	9.15	7.09	53.08
1913	2.81	8.23	9.51	14.15	12.90	6.93	54.51
1914	6.92	7.05	9.94	9.40	10.01	9.37	52.69
Mean	6.71	8.73	9.80	10.60	9.93	7.73	53.49
Dalhart, Tex.:							
1908	5.92	10.92	12.07	9.18	9.89	7.95	55.93
1909	8.53	9.90	10.89	11.69	10.57	7.84	59.40
1910	8.54	8.18	12.02	11.63	8.82	8.44	57.63
1911	7.56	9.90	12.37	9.71	10.90	8.77	59.21
1912	8.21	10.24	8.48	11.10	9.13	6.75	53.91
1913	7.69	10.06	8.71	12.70	10.77	6.34	56.27
1914	6.54	7.81	10.26	8.84	9.06	8.23	51.81
Mean	7.57	9.57	10.69	10.69	9.88	7.76	56.31
Amarillo, Tex.:							
1907	6.36	8.04	9.59	10.68	9.40	7.91	51.98
1908	7.31	9.28	10.38	8.07	8.57	6.77	50.38
1909	8.14	10.02	10.34	9.97	9.66	8.42	56.55
1910	8.50	8.03	12.00	12.18	8.80	9.10	58.61
1911	7.36	10.10	11.48	7.48	8.89	7.28	52.59
1912	7.05	9.90	8.99	10.95	9.49	6.49	52.87
1913	7.70	9.76	7.01	12.69	10.34	5.90	53.40
1914	6.70	6.74	10.12	8.75	8.93	8.04	49.28
Mean	7.39	8.98	9.99	10.10	9.26	7.49	53.21

HAIL.

The damage due to hail in the southern portion of the Great Plains is of minor importance. The hailstorms usually occur before the first of June. Fortunately, most of the profitable crops of this section can be seeded after this date. Furthermore, under favorable conditions, both the grain and forage sorghums have the ability to make a rapid recovery after being badly damaged by hail.

TEMPERATURE.

There is a wide range in the daily temperature of this region. This is especially noticeable during the early spring and late fall. The entire growing season is characterized by hot days and cool nights. This does not greatly affect the crops most commonly grown, however, but is doubtless one of the reasons why some crops, like corn and cotton, can not be more successfully produced.

SOIL.

For the purpose of this bulletin, the soil at the stations under study may be divided into two different types known as "tight land" and "loose land." The former varies from a sandy clay to a light sandy loam, and the latter varies from a light sandy loam to almost pure sand. There is very little difference in the productivity of these two types of soil, but they demand different treatment to produce the best results.

Generally speaking, the sandy soils give more trouble from blowing and drifting than do the heavier soils. On the other hand, they have the advantage of being more receptive of rainfall. On the sandy soils tillage implements which do not pulverize the surface but leave it in a rough condition should be used. At Garden City and Dalhart much difficulty has been experienced in handling this class of soils so as to prevent blowing. The soil at Amarillo is heavy, and little difficulty is there experienced from this source.

EXPERIMENTAL WORK.

Work was started at the Garden City station and the first crop produced in 1907. The Dalhart station was started in 1907 and the first crop was produced in 1908. The first crop was produced at Amarillo in 1906. In the fall of 1909 this station was moved to a new location and the first crop at the new location was produced in 1910. In preparing the tables covering these studies the yield of the crop for the first year at each of the stations has not been used, because the land was uniform in its preparation. The yield of the 1910 crop at Amarillo has not been included on account of the station being moved.

At all of these stations an attempt has been made to produce all of the farm crops that could reasonably be expected to grow successfully in this region. Not only has this practice been rigidly adhered to, but an effort has also been made to grow these crops under as many different methods of tillage as would be met with in ordinary farm practice. In other words, the range of preparation and cultivation has been from the extensive to the intensive system of farming.

SMALL GRAIN.

Spring wheat, winter wheat, oats, and barley will be considered in this study under this heading. The greatest disadvantages attending the growth of small grains in the southern portion of the Great Plains are the unfavorable climatic conditions prior to and immediately after seeding. The precipitation table shows that the rainfall from September 1 to May 1 is usually very light. The soil is very dry at the time for seeding small-grain crops. This is especially true if a crop has been grown on the land the previous summer. It is difficult to secure a stand of small grain when seeded under these conditions. As a result of the scant rainfall and the dry soil at seeding time the growth of the young plants is so retarded that they do not make a sufficient growth to protect themselves from soil blowing, which is most severe during March and April. When soil blowing starts on a field of small grain it is almost impossible to stop it without some heavy cultivation, which is impossible without destroying part of the crop. There are other and minor factors influencing the growing of small grains which are not discussed in this bulletin. There will undoubtedly be occasional seasons of heavy rainfall, when a crop of small grain might be successfully grown, but as a general practice the growing of small grains in this section can not be too severely condemned.

The results of the experimental work in the production of wheat, oats, and barley in the Great Plains by the Office of Dry-Land Agriculture have been published in separate bulletins (Nos. 214, 218, and 222, respectively) in the present series.

SORGHUMS.

Experimental work with the saccharine sorghums has been chiefly along the lines of variety and rate-of-seeding tests. On the whole, the yields have been very satisfactory. Very little work has been done in studying methods of preparation of the land for these crops. It is probable, however, that their relative response to differences in cultural methods is substantially the same as that of kafir and milo.

PRESENTATION OF RESULTS.

Tables IV to XII, inclusive, present the results of experimental work with corn, milo, and kafir at the Garden City, Dalhart, and Amarillo stations. These tables give for each station the yields of grain and stover each year, the average yield of each for the whole period of years under study, the value of the crop, the cost of producing it, and the resulting profit or loss.

In order to compare the relative profitableness of different methods it has been necessary to assign values to the products and to determine the relative costs of producing the crops by the different methods under study.

An accurate record of all the farm operations performed by the various methods under trial has been kept at each station. The average of these for the three stations is presented in Table III. It is recognized that this table does not exactly represent the requirements of any one of the stations, but the average seems to afford a fair basis of comparison. From estimates and determinations of an average day's work the cost of each cultural operation has been computed and is given in the table. In arriving at these items of cost a wage scale of $2 a day for a man and $1 a day for a horse has been allowed. Fifteen cents per acre for wear and tear on the binder is added to the labor cost of harvesting. An allowance of 8 per cent on a valuation of $20 per acre is added for taxes and interest on the land.

To these items must finally be added a charge of 22 cents per acre for seed in the case of corn, as shown in Table III, and 17 cents per acre for kafir or milo seed.

TABLE III.—*Comparative cost per acre of producing corn*[1] *by different methods at Garden City, Kans., and Dalhart and Amarillo, Tex.*

Method of preparation.	Number of operations.				Cost of preparation.	Cost per acre.				Interest and taxes.	Total cost of production.		
	Plowing.	Harrowing.	Disking.	Subsoiling.		Seed.	Planting.	Cultivating.	Harvesting.		In dollars.	In stover, at $4 per ton.	In grain at 40 cents per bushel.
Listed	......	1	1	......	$0.92	$0.22	$0.60	$1.14	$1.50	$1.60	5.98	1.50	15.0
Spring plowed	1	1.4	.6	......	2.40	.22	.25	1.14	1.50	1.60	7.11	1.78	17.8
Fall plowed	1	1.4	1.1	......	2.78	.22	.25	1.14	1.50	1.60	7.49	1.87	18.7
Subsoiled	1	1.4	1.1	0.5	3.47	.22	.25	1.14	1.50	1.60	8.18	2.05	20.5
Summer tilled	1.4	8.3	3	......	6.05	.22	.25	1.14	1.50	3.20	12.36	3.09	30.9

[1] Based on three cultivations. With the reduction of 5 cents per acre in the cost of seed, the same figures are used for both kafir and milo.

To determine the value of the crop is even more difficult. The farm value of corn in the Great Plains on December 1 for the 10 years ending with 1914 has been 51 cents per bushel. The writers have used in this study a valuation for each of the three crops of 40 cents per bushel in the shock. This allows 11 cents per bushel to complete the harvesting. In the territory under consideration, these crops are fed locally and a large part of them without husking or thrashing.

The average price of hay for the same territory during the same time has been $6.22 per ton. An arbitrary value of $4 per ton is assigned to the stover or fodder from each of the crops. This probably is an overvaluation of milo, and possibly of corn, in comparison with kafir. The corn roughage is of a much better quality than in better corn sections. In many cases it contained some grain, but not enough to warrant husking. In some instances, as is shown in detail in the tables, the only production from milo and kafir has been that of roughage. This is an indication of generally unfavorable conditions and scarcity of feed. In such years any feed is comparatively valuable, as it makes it possible to carry over stock without loss or a reduction in numbers so serious as to unbalance the farming system.

For the sake of uniformity the term "stover" is used in all the tables.

RESULTS WITH CORN AT INDIVIDUAL STATIONS.

The results with corn at these stations have been presented in a bulletin entitled "Corn in the Great Plains Area: Relation of Cultural Methods to Production." As this bulletin will have a somewhat different circulation from that one, and as it seems desirable to show the results with corn in comparison with those of the other two important feed crops, milo and kafir, they are here presented.

CORN AT GARDEN CITY.

With the exception of a very light grain yield in 1914, which was included in the stover weight, corn has not matured grain at Garden City; therefore it can be considered only as a fodder crop. A study of Table IV shows little difference in the yields obtained by spring and fall plowing. A slight difference does exist between the yields obtained where corn follows corn and where corn is grown after small grains. The difference is in favor of the first-named crop sequence, indicating that corn leaves the land in better condition for a succeeding crop than small grain does. Subsoiling has increased the yield over listing and fall and spring plowing, but the increased yield has been just sufficient to balance the extra expense incurred in using this method of seed-bed preparation. Listing gives the lowest average yield of fodder, but since this method is the least expensive it has been productive of the smallest loss. Corn following summer tillage has produced the highest yields, but as this is the most expensive method under trial it has resulted in the greatest loss. As calculated in Table IV, corn at this station has not been produced at a profit by any method under trial.

TABLE IV.—*Summary of yields and digest of the cost of production of corn by different tillage methods and crop sequences at Garden City, Kans., 1909 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed.				Subsoiled after corn (1 plat).		Listed after corn (2 plats).		Summer tilled (1 plat).	
	After corn (1 plat).		After small grain (11 plats).		After corn (1 plat).		After small grain (11 plats).							
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yield for the year:	*Bus.*	*Lbs.*	*Bus.*	*Lbs.*	*Bus.*	*Lbs.*	*Bus.*	*Lbs.*	*Bus.*	*Lbs.*	*Bus.*	*Lbs.*	*Bus.*	*Lbs.*
1909	......	......	0	2,972	......	......	0	3,446	......	......	0	2,180	......	......
1910	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1911	0	1,400	0	934	0	1,100	0	1,269	0	750	0	695	0	4,000
1912	0	4,620	0	4,498	0	5,580	0	3,935	0	4,500	0	5,570	0	5,700
1913	[1] H.	H.	H.	H.	H.	H.	H.	H.	H.	H.	H.	H.	H.	H.
1914 [2]	0	3,040	0	2,668	0	2,460	0	2,100	0	4,840	0	2,830	0	4,320
Average	0	3,020	0	2,768	0	3,047	0	2,688	0	3,363	0	2,819	0	4,700
Crop value, cost, etc.:														
Value	......	$6.04	......	$5.54	......	$6.09	......	$5.38	......	$6.73	......	$5.64	......	$9.40
Cost	$7.49		$7.49		$7.11		$7.11		$8.18		$5.98		$12.36	
Loss	−1.45		−1.95		−1.02		−1.73		−1.45		− .34		−2.96	

[1] H=Destroyed by hail.

[2] Very small yield of grain; weight included with stover.

CORN AT DALHART.

Six crops of corn have been grown at the Dalhart station. In three of the years under study grain was produced, while in the other three years nothing but stover was produced. The best yield was obtained in 1914, when optimum seasonal conditions for the production of this crop prevailed. Listing has been productive of the highest average yield of grain, but it is thought that this may be due to the fact that the listed plat occupies such a position on the farm that it sometimes receives considerable run-off. Because of the low cost of this method of preparation it gives the greatest profit. Summer tillage is the most costly method of seed-bed preparation; consequently it returns rather a low profit, although it insures a good yield of fodder every year. The difference between the average yields by spring and fall plowing is very slight.

TABLE V.—*Summary of yields and digest of the cost of production of corn by different tillage methods and crop sequences at Dalhart, Tex., 1909 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed.				Listed after corn (1 plat).		Summer tilled (1 plat).	
	After corn (1 plat).		After small grain (12 plats).		After corn (1 plat).		After small grain (7 plats).					
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yield for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1909........	0	1,000	0	946	0	700	0	1,014	0	2,250	0	3,400
1910........	8.6	3,160	9.2	2,947	15.1	3,610	15.3	2,914	25.6	3,340	25.6	4,110
1911........	0	4,000	0	2,771	0	4,000	0	2,708	0	2,350	0	3,000
1912........	7.4	2,250	14.1	2,779	10.5	2,200	9.7	2,751	21.0	3,100	23.0	3,300
1913........	0	2,000	0	2,405	0	2,150	0	1,037	0	1,750	0	6,150
1914........	35.6	3,855	20.3	3,566	31.5	3,690	17.0	3,255	25.1	2,740	30.8	3,440
Average..	8.6	2,711	7.3	2,569	9.5	2,725	7.0	2,280	14.0	2,588	13.7	3,900
Crop value, cost, etc.:												
Value......	$3.44	$5.42	$2.92	$5.14	$3.80	$5.45	$2.80	$4.56	$5.60	$5.18	$5.48	$7.80
Total value.	$8.86		$8.06		$9.25		$7.36		$10.78		$13.28	
Cost........	7.49		7.49		7.11		7.11		5.98		12.36	
Profit....	1.37		.57		2.14		.25		4.80		.92	

CORN AT AMARILLO.

Seven crops of corn have been grown at Amarillo, Tex., and, although only one complete grain failure is recorded, the yields of four years were so low that husking would have been impracticable in farm practice. The 1908 yields varied from 14.7 to 27.6 bushels per acre. If such yields could be obtained consistently, the growing of corn in this section would be justified. The average yields, however, are not sufficient to cover the cost of production. All methods have produced fodder each year, but in only one year has there been a creditable production of grain.

The differences in the yield from different methods have been comparatively small. Summer-tilled land shows a small increase in the yield of both grain and stover over all other methods. Fall plowing has proved a somewhat better preparation than either spring plowing or listing. Subsoiling has failed to increase yields over fall plowing.

Listing shows a small profit of 67 cents per acre. All other methods show losses ranging from 19 cents per acre by fall plowing after corn to $2.85 on summer-tilled land.

Table VI.—*Summary of yields and digest of the cost of production of corn by different tillage methods and crop sequences at Amarillo, Tex., 1907 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed.				Subsoiled after corn (1 plat).		Listed after corn (2 plats).		Summer tilled (1 plat).	
	After corn. (1 plat).		After small grain (11 plats).		After corn (1 plat).		After small grain (3 plats).							
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover	Grain	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yields for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1907	1.4	3,270	2.3	2,997	3.1	3,280	2.1	3,010	1.1	3.490	2.2	2,935	5.7	3,710
1908	22.9	4,580	19.8	3,107	20.3	3,300	14.7	2,863	25.7	3,810	24.7	2,390	27.6	3,700
1909	2.7	1,310	0	1,596	.6	560	0	1,383	1.7	990	5.4	1,043	6.4	1,890
1911	9.2	2,075	8.9	2,145	8.1	1,945	9.5	1,960	7.1	1,720	7.8	1,998	9.3	2,050
1912	.7	1,680	1.7	1,848	2.6	2,160	1.1	1,829	1.0	2,080	1.7	2,015	3.3	2,840
1913	0	380	0	773	0	700	0	383	0	430	0	225	0	1,750
1914	3.6	4,140	5.1	3,641	1.1	1,500	2.6	2,733	5.1	4,850	7.0	2,870	8.0	5,320
Crop value, cost, etc.: Average	5.8	2,491	5.4	2,301	5.1	1,921	4.3	2,023	6.0	2,481	7.0	1,925	8.6	3,037
Value	$2.32	$4.98	$2.16	$4.60	$2.04	$3.84	$1.72	$4.05	$2.40	$4.96	$2.80	$3.85	$3.44	$6.07
Total value	$7.30		$6.74		$5.88		$5.77		$7.36		$6.65		$9.51	
Cost	7.49		7.49		7.11		7.11		8.18		5.98		12.36	
Profit or loss	− .19		− .75		−1.23		−1.34		− .82		.67		−2.85	

RESULTS WITH MILO AND KAFIR AT INDIVIDUAL STATIONS.

Milo is undoubtedly the leading grain crop grown in this section and has given surer and better grain yields, on the average, than any other crop grown at the stations included in this study. Two types of this crop are commonly grown, namely, Standard and Dwarf. The Standard type grows a stalk averaging about 4½ feet in height, depending upon seasonal conditions, while the Dwarf probably will not average over 3 feet. Differences in yield due to seasonal conditions so far overshadow any differences in type that it is almost impossible to draw any definite conclusions as to just which of the two types gives the better yield. It is probable, however, that the average yield for a series of years would be in favor of the Dwarf type. If the grain is to be headed and the stalks left in the field, it would probably be advisable to plant the Dwarf, since it is not so high and can be more easily headed with a header or by hand. The Standard is more easily handled with a row binder, and where the stalks are to be saved and fed in the bundle or the crop used for silage this type should be planted.

Two varieties of kafir are also universally grown. These are the Standard and the Dwarf, and what has been said of the different types of milo may also be said of these kafir varieties. Kafir differs from milo in that it requires a longer season to mature and is frequently injured by frost, as will be seen by referring to the tables presented in connection with these studies.

Milo has usually given the highest grain yield, while kafir has given uniformly higher yields of fodder. Not only does kafir give a larger yield of fodder than milo, but the quality is far superior. This is especially true if an attempt is made to harvest the milo crop for both seed and fodder. The reason for this is that the milo stalk ripens before the head and there are very few leaves left on a hard, woody stalk at the time of harvest for grain. With kafir the ripening is just the reverse of milo; that is, the head ripens before the stalk, which makes it possible to harvest a grain crop when grain is produced and at the same time a fodder crop of good quality.

MILO AT GARDEN CITY.

Six crops of milo have been grown at Garden City, Kans. Since three of these failed to produce grain, the average grain yield is very low. Yields of milo grown after summer tillage are not included in the experiments here reported. The work has been rearranged and extended to include it and a wide range of methods of seed-bed preparation. Of the methods here reported there is not sufficient difference in the average yields to indicate the great superiority of any one over the others. The lowest yield of both grain and stover has been on spring-plowed land continuously cropped to milo. The highest yield has been from fall plowing after small grain. The former method has resulted in an average loss of 83 cents per acre, while the latter has given a profit of $2.07 per acre. Considering the value of both grain and stover, only two of the six crops on fall-plowed and on listed land have been produced at a loss, while only one crop on spring-plowed land has returned a profit.

It will be seen that at this station milo stover at a valuation of $4 per ton has returned a greater value than the grain when priced at 40 cents a bushel. At the other stations the opposite has been true in nearly every case. This is an important consideration in studying milo yields, as the crop is usually grown for the grain.

TABLE VII.—*Summary of yields and digest of the cost of production of milo by different tillage methods and crop sequences at Garden City, Kans., 1909 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed, after milo (1 plat).		Listed, after milo (1 plat).	
	After milo (1 plat).		After small grain (2 plats).					
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yields for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1909	0	3,950	0	5,345	0	3,370	0	3,830
1910	14	2,150	21.8	3,275	7.6	1,940	12.4	2,380
1911	0	760	0	360	0	380	0	0
1912	30.5	3,120	27.1	3,010	25	2,750	29.1	3,775
1913	0	260	0	770	0	620	0	300
1914	8.5	2,670	13.9	3,175	4.8	2,180	11.2	1,930
Average	8.8	2,152	10.5	2,656	6.2	1,873	8.8	2,036
Crop value, cost, etc.:								
Value	$3.52	$4.30	$4.20	$5.31	$2.48	$3.75	$3.52	$4.07
Total value	$7.82		$9.51		$6.23		$7.52	
Cost	7.44		7.44		7.06		5.93	
Profit or loss	.38		2.07		− .83		1.59	

MILO AT DALHART.

Milo has given higher average yields at Dalhart, Tex., than at any of the other stations, and there is a greater range in the average profits per acre from different methods. The grain yields vary from a complete failure to 69 bushels per acre. Records for six years are available from this station. In all but two years milo has been grown at a profit by all methods under trial. Milo following summer tillage has been profitable in all years except one. This fact, combined with the high average yield of both grain and stover and the net profit of $14.21 per acre that it returns, makes it a method of great importance for the Dalhart region. The crop was harvested in bulk and converted into ensilage in 1913, but the summer-tilled plat produced an estimated yield of at least 600 pounds of grain per acre. The yields obtained show that summer tillage has insured a grain yield in dry years, and, except in one year, has increased the yield over that from other methods.

The listing method returns the next highest profits per acre. The plat devoted to this method occupies a low place on the farm and may catch run-off water in sufficient quantity to increase the yields. The low cost of preparation by this method is a point in its favor.

The low yields obtained from milo following small grain by fall plowing have been due more to imperfect stands than to any other known factor, and it is hardly fair to compare these yields with those secured by other methods.

A study of the yields by fall and spring plowing where milo follows milo shows no appreciable difference in the value of these two methods. Both methods have given good profits.

TABLE VIII.—*Summary of yields and digest of the cost of production of milo by different tillage methods and crop sequences at Dalhart, Tex., 1909 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed after milo (1 plat).		Listed after milo (1 plat).		Summer tilled (1 plat).	
	After milo (1 plat).		After small grain (2 plats).							
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yield for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1909	2.8	1,660	3.8	3,000	3.3	3,990	3.8	1,590	14.7	4,980
1910	26.6	6,660	21.2	6,945	26.4	6,950	50.4	8,380	69.0	11,520
1911	19.1	4,270	0	755	5.9	2,000	23.6	3,330	27.8	3,530
1912	28.6	4,650	33.1	2,965	39.7	4,610	22.4	2,770	52.4	6,500
1913	0	1,750	0	2,275	0	1,800	0	1,250	[1] 10.3	3,600
1914	55.5	4,980	(2)	(2)	51.7	5,040	48.4	4,130	45.3	5,500
Average	22.1	3,995	11.6	3,188	21.2	4,065	24.8	3,575	36.6	5,938
Crop value, cost, etc.:										
Value	$8.84	$7.99	$4.64	$6.38	$8.48	$8.13	$9.92	$7.15	$14.64	$11.88
Total value	$16.83		$11.02		$16.61		$17.07		$26.52	
Cost	7.44		7.44		7.06		5.93		12.31	
Profit	9.39		3.58		9.55		11.14		14.21	

[1] Estimated yield; harvested in bulk for ensilage.

[2] Discontinued in 1914.

MILO AT AMARILLO.

Seven crops of milo have been grown at Amarillo, Tex., and grain yields were secured from six of them. Milo after small grain on fall plowing has given better average results than any other tillage method used at this station. General observation as to yields indicates that crop sequence has less influence than other factors. The yields of milo grown on fall-plowed land following small grain do not greatly exceed those obtained from different methods on land continuously cropped to milo. In fact, with the exception of summer tillage, there is little variation among the average yields by all the different methods under trial. Listing has produced the smallest quantity of stover, but this is of no great importance, as high grain yields are preferred to high stover yields. Four years out of the six milo after milo by spring plowing has given heavier yields than milo after milo by fall plowing, and one year out of three it has exceeded the yield on summer-tilled land. It is hardly fair to compare the practice of summer tillage at this station with other tillage methods, as it has been under trial only three years. In 1913, when because of the extreme drought all other methods failed even to set heads, milo on summer-tilled land made a yield of grain, which was destroyed by birds, estimated at 10 to 15 bushels to the acre.

TABLE IX.—*Summary of yields and digest of the cost of production of milo by different tillage methods and crop sequences at Amarillo, Tex., 1907 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed after milo (1 plat).		Listed after milo (2 plats).[1]		Summer tilled (1 plat).	
	After milo (1 plat).		After small grain (2 plats).							
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yields for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1907	21.6	4,170	27.9	4,175	18.1	2,560	31.7	3,810	....	....
1908	32.8	3,280	46.5	4,590	40.3	3,500	37.9	3,250	....	....
1909	.9	1,740	10.1	2,962	2.6	2,045	10.9	2,318	....	....
1910 [2]	....	....	....	....	....	....	....	....	....	....
1911	31.4	4,350	26.5	3,698	35.4	3,500	17.4	2,010	....	....
1912	27.4	2,760	26.7	3,050	33.5	3,290	25.4	2,515	24.1	3,570
1913	0	130	0	715	0	440	0	410	0	2,000
1914	29.0	4,010	24.5	3,810	17.6	3,050	23.3	1,880	27.	4,820
Average	20.4	2,920	23.2	3,286	21.1	2,626	20.9	2,313	17.1	3,463
Crop value, cost, etc.: Value	8.16	5.84	9.28	6.57	8.44	5.25	8.36	4.63	6.84	6.93
Total value	$14.00		$15.85		$13.69		$12.99		$13.77	
Cost	7.44		7.44		7.06		5.93		12.31	
Profit	6.56		8.41		6.63		7.06		1.46	

[1] Only one listed plat used until 1912.

[2] Station site changed in 1910; yields not used.

A comparison of the yields secured at Amarillo and Dalhart is of interest, because the two stations are only 90 miles apart, but they are located on altogether different types of soil. The Dalhart station has an average annual rainfall of 15.92 inches and is located on a sandy-loam soil, while the Amarillo station has a yearly precipitation of 20.95 inches and is located on a heavy, silty clay loam. Judging from the average rainfall, the yields at Amarillo should be greater than at Dalhart. The records show, however, that better average yields have been produced at Dalhart. This probably is due to the ability of the sandy soil at Dalhart to absorb a larger percentage of the annual rainfall.

KAFIR AT GARDEN CITY.

Kafir has been grown for six consecutive years at Garden City, Kans. The first crop was produced in 1909. With the exception of the year 1914, four different methods of seed-bed preparation and cultivation have been under study. In 1914 the growth of kafir after small grain was discontinued because of the repeated failures of the small-grain crop. During the six years that kafir has been grown at this station it has not produced a grain yield of any value except in 1912, when all methods gave good yields. The best yield was

27.8 bushels per acre on fall-plowed land following small grain. Kafir following small grain has, on the average, given slightly better yields of both grain and fodder than it has following kafir. These higher yields have doubtless been due to the repeated failure of the small-grain crop, which has left the ground partly summer tilled. There has been very little difference in the average grain yield by the different methods under study. From no method has this average yield been sufficient to cover the cost of its production. All methods have produced four good crops of forage. The average yield of fodder after fall plowing is above the average of any other method. The next highest yield has been after fall plowing following kafir.

Without exception the value of the forage has exceeded the value of the grain produced under all methods studied. Kafir after kafir on spring-plowed land has shown the lowest margin of profit, viz, 64 cents per acre. The greatest net profit per acre has been secured by growing kafir after small grain on fall-plowed land. The profit by this method is $3.78 per acre. The margin of profit from all methods has been small and, on the average, much lower than at Dalhart or Amarillo.

TABLE X.—*Summary of yields and digest of the cost of production of kafir by different tillage methods and crop sequences at Garden City, Kans., 1909 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed after kafir (1 plat).		Listed after kafir (1 plat).	
	After kafir (1 plat).		After small grain (2 plats).					
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yields for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1909	0	5,260	0	5,780	0	4,310	0	4,400
1910	5.0	3,880	9.6	6,800	2.2	3,550	2.7	3,820
1911	0	680	0	1,390	0	580	0	580
1912	27.8	5,970	25.1	5,745	22.5	5,400	20.6	5,805
1913	0	440	0	1,430	0	680	0	300
1914	6.7	3,340	(1)	(1)	3.7	2,940	3.8	2,750
Average	6.6	3,262	6.9	4,229	4.7	2,910	4.5	2,943
Crop value, cost, etc.:								
Value	$2.64	$6.52	$2.76	$8.46	$1.88	$5.82	$1.80	$5.89
Total value	$9.16		$11.22		$7.70		$7.69	
Cost	7.44		7.44		7.06		5.93	
Profit	1.72		3.78		.64		1.76	

(1) Discontinued in 1914.

A rotation of small grain and kafir is impracticable on account of the failure of small grain. Summer tillage should, therefore, be given a thorough trial, as it may prove to be the most profitable method. Experiments have been started to determine the most practical application of summer tillage for the growing of kafir.

KAFIR AT DALHART.

Kafir has been grown at Dalhart, Tex., for six years. During this time five different methods of seed-bed preparation and cultivation have been under study. Kafir after small grain on fall-plowed land was discontinued in 1914, on account of the impracticability of growing small grain. The results obtained during this study have on the whole been very satisfactory. The yields, and consequently the profits, obtained here are higher than at the other stations under study. There is also a wider range in the results obtained with the different cultural methods used, which would indicate that cultivation here is of more importance than at Garden City, Kans., or at Amarillo, Tex. The largest average net profit obtained was from the crop grown on land summer tilled the preceding year, amounting to $20.11 per acre. The method showing the least profit is that of fall plowing following small grain. The profit by this method was only $2.90, which is considerably below the average of the other methods used.

It is possible that the low profits shown by this method are due to the difficulty of securing a stand and to the fact that the small grains leave the soil very dry. Listing after kafir has given a net yield of $12.04 per acre, which is considerably higher than by any other method except summer tillage. Kafir after kafir on fall-plowed land has given an increased profit of $1.43 per acre over kafir following kafir on spring-plowed land.

After both listing and summer tillage the value of the grain crop alone has been sufficient to pay the cost of production. Under all methods the value of the forage has exceeded that of the grain.

TABLE XI.—*Summary of yields and digest of the cost of production of kafir by different tillage methods and crop sequences at Dalhart, Tex., 1909 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed after kafir (1 plat).		Listed after kafir (1 plat).		Summer tilled (1 plat).	
	After kafir (1 plat).		After small grain (2 plats).							
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yields for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1909	0	4,020	0	2,550	0	6,250	0	5,500	0	9,310
1910	30	10,140	17.9	9,075	18.7	8,420	55	12,270	75.5	18,310
1911	9.3	2,890	0	1,530	0	1,550	19.2	5,900	22.5	10,600
1912	0	5,500	5.5	4,625	0	6,000	9.7	3,950	29.8	9,500
1913	0	1,800	0	3,370	0	2,400	0	750	20.8	6,000
1914	44	7,760	(1)	(1)	39.2	7,100	17.3	5,260	37.8	6,230
Average	13.9	5,352	4.7	4,230	9.7	5,287	16.9	5,605	31.1	9,992
Crop value, cost, etc.:										
Value	$5.56	$10.70	$1.88	$8.46	$3.88	$10.57	$6.76	$11.21	$12.44	$19.98
Total value	$16.26		$10.34		$14.45		$17.97		$32.42	
Cost	7.44		7.44		7.06		5.93		12.31	
Profit	8.82		2.90		7.39		12.04		20.11	

(1) Discontinued in 1914.

KAFIR AT AMARILLO.

The results of seven years with kafir at Amarillo, Tex., are available. During this time only two complete grain failures have been recorded. While the net profits shown at Amarillo are not as large on the average as those obtained at Dalhart, Tex., they are considerably above those at Garden City, Kans. Kafir after summer tillage is the only method that shows a loss, but, as this method has been carried on for only three years, it is possible that this loss does not represent what might reasonably be expected by this method if it were tested for a longer time. The value of kafir following kafir on fall-plowed land exceeds that of kafir after kafir on spring-plowed land by $1.26 per acre. The largest profit by any method used has been obtained with kafir after small grain. For the seven years under study this method shows an average profit of $8.21 per acre.

Table XII.—*Summary of yields and digest of the cost of production of kafir by different tillage methods and crop sequences at Amarillo, Tex., 1907 to 1914, inclusive.*

Yields, values, etc. (average per acre).	Fall plowed.				Spring plowed after kafir (1 plat).		Listed after kafir (2 plats).[1]		Summer tilled. (1 plat).	
	After kafir (1 plat).		After small grain (2 plats).							
	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.	Grain.	Stover.
Yields for the year:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
1907	13.3	7,040	16.7	7,355	10.7	4,630	11.8	4,730	....	....
1908	30.8	5,360	38.4	7,020	29.2	4,820	27.2	4,940	....	....
1909	1.4	1,513	4.6	3,908	1.6	2,026	5.3	2,684	....	....
1910[2]	....	....	....	....	....	....	....	....	....	....
1911	21.8	7,280	18.9	8,310	21.7	4,350	8.0	1,500	....	....
1912	0	5,660	0	6,020	0	6,870	0	5,215	0	6,160
1913	0	170	0	755	0	280	0	620	0	2,240
1914	12.0	3,940	6.9	4,340	8.3	3,790	12.5	2,760	7.0	4,880
Average	11.3	4,423	12.2	5,387	10.2	3,824	9.3	3,207	2.3	4,427
Crop value, cost, etc.:										
Value	$4.52	$8.85	$4.88	$10.77	$4.08	$7.65	$3.72	$6.41	$0.92	$8.85
Total value	$13.37		$15.65		$11.73		$10.13		$9.77	
Cost	7.44		7.44		7.06		5.93		12.31	
Profit or loss	5.93		8.21		4.67		4.20		−2.54	

[1] Only one plat used until 1912.

[2] Station site changed in 1910; yields not used.

GENERAL DISCUSSION.

With the exception of the rainfall, which is less at Dalhart, Tex., than at Garden City, Kans., and Amarillo, Tex., the climatic conditions at the three stations under study are very similar. The soils of the three stations are of different types, but they are fairly representative of the more important agricultural types of soil to be found in the southern Great Plains area.

Experimental work was started one year earlier at Amarillo than at the other stations. Aside from this it has been carried on during the same years at each of the stations.

Summer tillage for milo and kafir has only recently been put under trial at Garden City. With this exception the same cultural methods have been used at each place. Small grains in this area have given generally unsatisfactory returns, although they have been much better at Amarillo than at either of the other two stations.

Saccharine sorghums have proved well adapted to conditions in the southern Great Plains area and usually have given good yields. The same cultural work has not been done with them as with the other crops. In general they may be expected to show about the same response to cultural conditions as is shown by the grain sorghums, for which results are here reported.

The results of this work show that corn can be depended upon to produce good crops of feed in this section. It does not, however, produce as big a tonnage of feed as kafir and is not as reliable as either kafir or milo in the production of grain. In trials covering six years at Garden City it has failed to produce a grain crop by any method. At Dalhart it has produced good crops of grain in three of the six years that it has been under trial. At Amarillo it has made but one creditable grain crop in seven years. Because of its comparatively poorer adaptation to conditions, it does not show relatively as great a response to cultural practices as does either kafir or milo.

Both milo and kafir have given higher average yields than corn at all of the stations. They have also been safer crops, having made crops of grain in some years when corn did not. They have also been more responsive to cultural operations, thus proving their better adaptation to conditions. On the sandy lands of this area corn makes a better showing in comparison with these crops than it does on the heavy, "tight lands," on which corn has little place in this section. When a comparison is made between milo and kafir it is seen that milo has given the better yields of grain and that kafir has given the better yields of roughage. Kafir, however, has shown a somewhat greater response to methods that, like summer tillage, increase the yields. When equal values are assigned to the grain and to the roughage from each of the crops, the total return is generally about the same from each. At Garden City the grain crop alone has not been sufficient to pay for the cost of production. At Dalhart both crops have produced sufficient grain by all methods to pay a profit. At Amarillo milo has returned a profit from the grain alone by some methods. The crop of kafir grain at Amarillo was not sufficient by any method to pay the cost of producing the crop.

When a value, believed to be a conservative one, is assigned to the fodder, both crops show a profit from nearly all methods under trial at all the stations. The only two exceptions are milo following milo by spring plowing at Garden City and kafir following summer tillage at Amarillo, where the summer tillage method has been on trial for only three years, all of which have been relatively unfavorable.

The most important results of the investigations, of which this is a partial report, are the demonstrations that this region is not adapted to the successful growth of small-grain crops, but that it is well adapted to forage crops and to certain types of grain sorghums when proper methods of tillage and crop sequence are practiced. This means that this region is undoubtedly destined again to become an important stock-producing section. It yet remains to be determined what classes of live-stock enterprises offer the greatest opportunities to the small farmers who have taken the place of the stockmen who formerly conducted an extensive and profitable business on the open ranges. It is certain that live stock of some kind must be grown to consume the forage and grain crops which can and will be grown in this region in enormously increasing quantities as its agricultural possibilities become better understood.

Although these investigations have so far demonstrated that but few crops have proved successful when grown by certain methods, it must not be understood that the limit has been reached either in crops or methods. On the contrary, these experiments tend to show that other crops and other methods may be developed which will produce even better results.

These investigations are being developed and modified to meet the requirements and the agricultural resources of the southern Great Plains area. The problem of utilizing the forage and grain crops for the production of live-stock products is now of vital importance, and with its solution the agricultural resources of this region will be materially increased.

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